FIG. 1

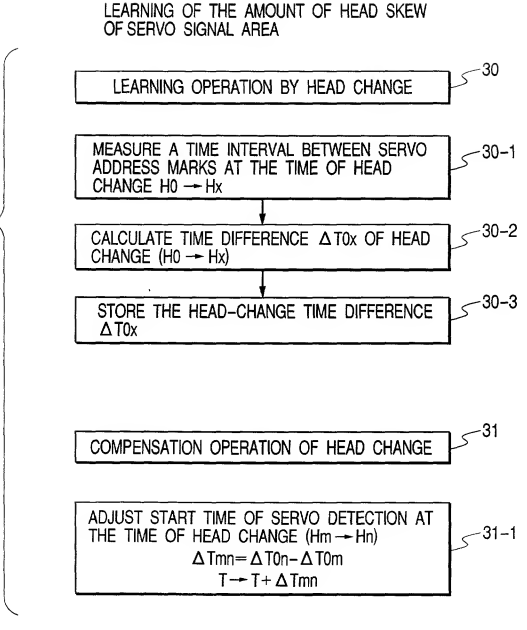

LEARNING OF THE AMOUNT OF HEAD SKEW OF SERVO SIGNAL AREA
LEARNING OPERATION BY HEAD CHANGE
30
MEASURE A TIME INTERVAL BETWEEN SERVO ADDRESS MARKS AT THE TIME OF HEAD CHANGE H0 → Hx
30-1
CALCULATE TIME DIFFERENCE ΔT0x OF HEAD CHANGE (H0 → Hx)
30-2
STORE THE HEAD-CHANGE TIME DIFFERENCE ΔT0x
30-3
COMPENSATION OPERATION OF HEAD CHANGE
31
ADJUST START TIME OF SERVO DETECTION AT THE TIME OF HEAD CHANGE (Hm → Hn)
ΔTmn = ΔT0n - ΔT0m
T → T + ΔTmn
31-1

FIG. 2

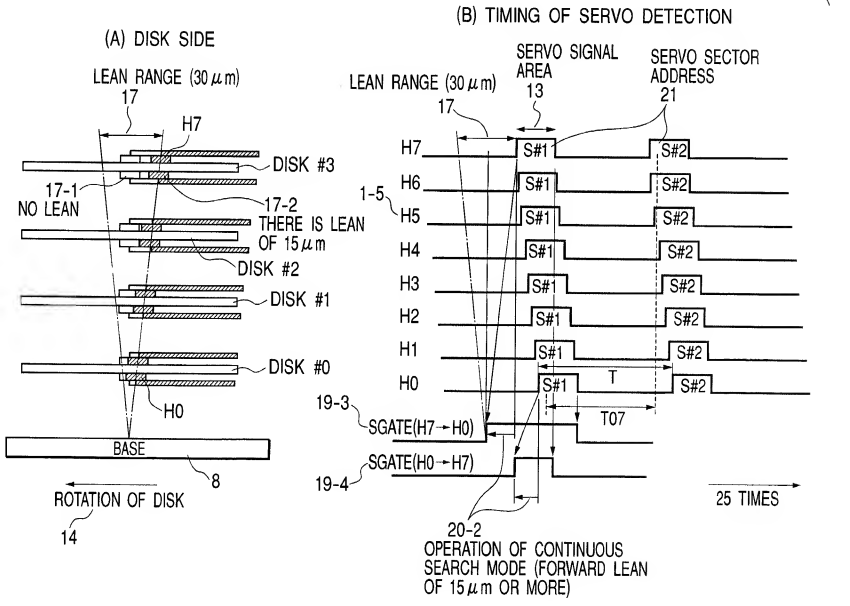

(A) DISK SIDE
LEAN RANGE (30 μm)
17
H7
DISK #3
17-1
NO LEAN
17-2
THERE IS LEAN OF 15 μm
DISK #2
DISK #1
DISK #0
H0
BASE
8
ROTATION OF DISK
14
(B) TIMING OF SERVO DETECTION
LEAN RANGE (30 μm)
17
SERVO SIGNAL AREA
13
SERVO SECTOR ADDRESS
21
H7
H6
H5
H4
H3
H2
H1
H0
1-5
S#1
S#2
T
T07
19-3
SGATE(H7→H0)
19-4
SGATE(H0→H7)
25 TIMES
20-2
OPERATION OF CONTINUOUS SEARCH MODE (FORWARD LEAN OF 15 μm OR MORE)

FIG. 3

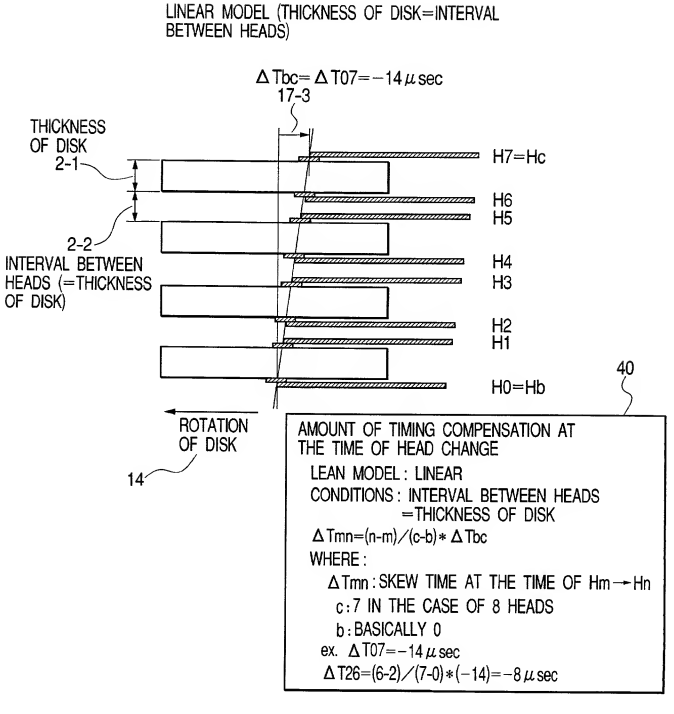

LINEAR MODEL (THICKNESS OF DISK=INTERVAL BETWEEN HEADS)
ΔTbc=ΔT07=−14μsec
17-3
THICKNESS OF DISK
2-1
2-2
INTERVAL BETWEEN HEADS (=THICKNESS OF DISK)
H7=Hc
H6
H5
H4
H3
H2
H1
H0=Hb
ROTATION OF DISK
14
40
AMOUNT OF TIMING COMPENSATION AT THE TIME OF HEAD CHANGE
LEAN MODEL : LINEAR
CONDITIONS : INTERVAL BETWEEN HEADS =THICKNESS OF DISK
ΔTmn=(n-m)/(c-b)*ΔTbc
WHERE :
ΔTmn : SKEW TIME AT THE TIME OF Hm→Hn
c : 7 IN THE CASE OF 8 HEADS
b : BASICALLY 0
ex. ΔT07=−14μsec
ΔT26=(6-2)/(7-0)*(−14)=−8μsec

FIG. 4

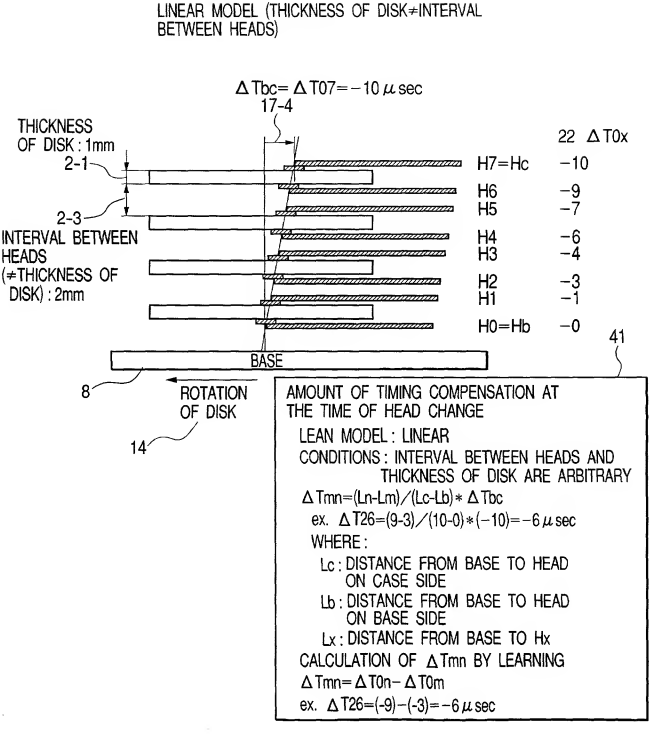
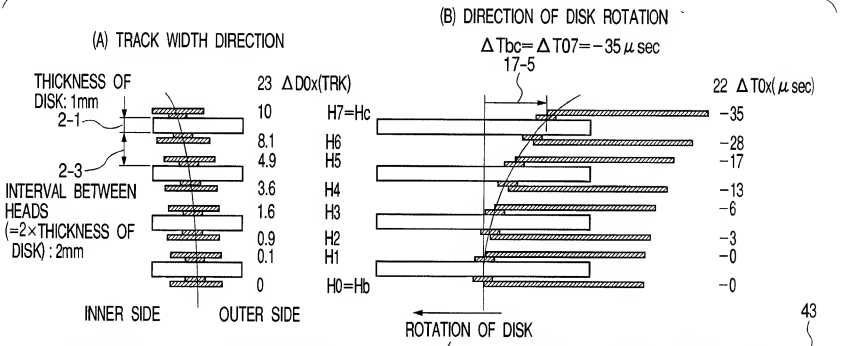

LINEAR MODEL (THICKNESS OF DISK≠INTERVAL BETWEEN HEADS)
ΔTbc= ΔT07=−10 μsec
17-4
THICKNESS OF DISK : 1mm
2-1
2-3
INTERVAL BETWEEN HEADS (≠THICKNESS OF DISK) : 2mm
22 ΔT0x
H7=Hc −10
H6 −9
H5 −7
H4 −6
H3 −4
H2 −3
H1 −1
H0=Hb −0
41
BASE
8
ROTATION OF DISK
14
AMOUNT OF TIMING COMPENSATION AT THE TIME OF HEAD CHANGE
LEAN MODEL : LINEAR
CONDITIONS : INTERVAL BETWEEN HEADS AND THICKNESS OF DISK ARE ARBITRARY
ΔTmn=(Ln-Lm)/(Lc-Lb)*ΔTbc
ex. ΔT26=(9-3)/(10-0)*(−10)=−6 μsec
WHERE :
Lc : DISTANCE FROM BASE TO HEAD ON CASE SIDE
Lb : DISTANCE FROM BASE TO HEAD ON BASE SIDE
Lx : DISTANCE FROM BASE TO Hx
CALCULATION OF ΔTmn BY LEARNING
ΔTmn=ΔT0n−ΔT0m
ex. ΔT26=(-9)−(-3)=−6 μsec

FIG. 5

NONLINEAR MODEL (SQUARE CURVE)



AMOUNT OF OFFSET COMPENSATION AT THE TIME OF HEAD CHANGE

ΔDmn=ΔD0n-ΔD0m

ex. ΔD26=(8.1)−(0.9)=7.2 (TRK)

@MODEL : $\Delta D0x=\Delta Dbc/Lbc^2\times Lbx^2$

WHERE :

Lbx : DISTANCE FROM Hb TO Hx (mm)

c : 7 IN THE CASE OF 8 HEADS

b : BASICALLY 0

42

AMOUNT OF TIMING COMPENSATION AT THE TIME OF HEAD CHANGE

ΔTmn=ΔT0n-ΔT0m

ex. ΔT26=(-28)−(-3)=−25 (μsec)

@MODEL : $\Delta T0x=\Delta Tbc/Lbc^2\times Lbx^2$

WHERE :

Lbx : DISTANCE FROM Hb TO Hx (mm)

c : 7 IN THE CASE OF 8 HEADS

b : BASICALLY 0

FIG. 6

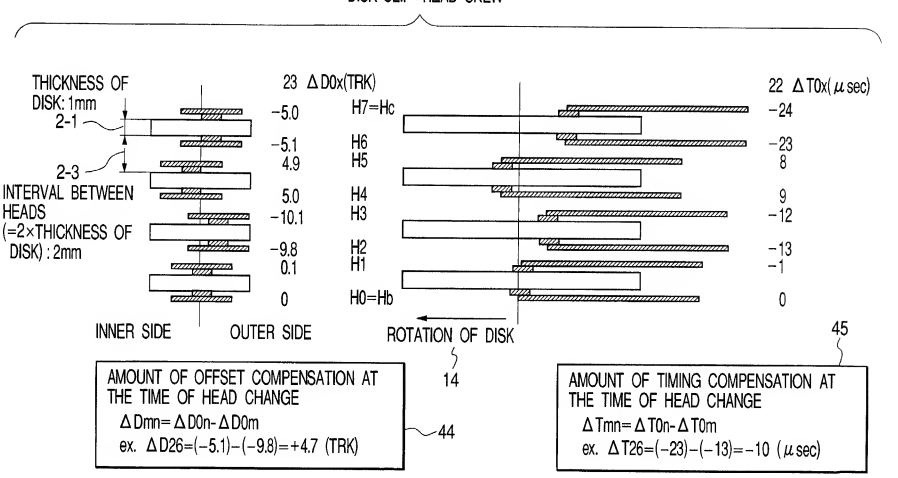

DISK SLIP+HEAD SKEW
THICKNESS OF DISK: 1mm
2-1
2-3
INTERVAL BETWEEN HEADS (=2×THICKNESS OF DISK) : 2mm
23 ΔD0x(TRK)
-5.0
-5.1
4.9
5.0
-10.1
-9.8
0.1
0
H7=Hc
H6
H5
H4
H3
H2
H1
H0=Hb
22 ΔT0x(μsec)
-24
-23
8
9
-12
-13
-1
0
INNER SIDE
OUTER SIDE
ROTATION OF DISK
45
14
AMOUNT OF OFFSET COMPENSATION AT THE TIME OF HEAD CHANGE
ΔDmn=ΔD0n-ΔD0m
ex. ΔD26=(-5.1)-(-9.8)=+4.7 (TRK)
44
AMOUNT OF TIMING COMPENSATION AT THE TIME OF HEAD CHANGE
ΔTmn=ΔT0n-ΔT0m
ex. ΔT26=(-23)-(-13)=-10 (μsec)

FIG. 7

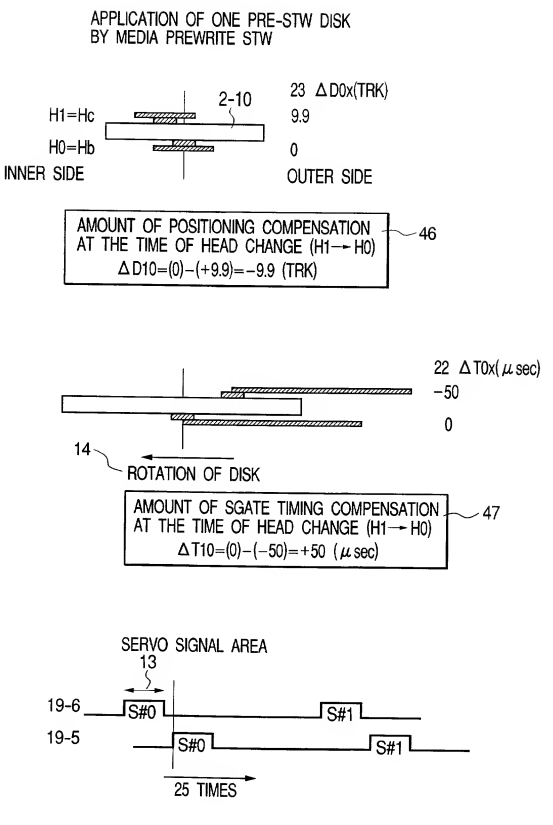

APPLICATION OF ONE PRE-STW DISK
BY MEDIA PREWRITE STW
2-10
23 ΔD0x(TRK)
H1=Hc
9.9
H0=Hb
0
INNER SIDE
OUTER SIDE
AMOUNT OF POSITIONING COMPENSATION
AT THE TIME OF HEAD CHANGE (H1→H0)
ΔD10=(0)−(+9.9)=−9.9 (TRK)
46
22 ΔT0x(μsec)
−50
0
14
ROTATION OF DISK
AMOUNT OF SGATE TIMING COMPENSATION
AT THE TIME OF HEAD CHANGE (H1→H0)
ΔT10=(0)−(−50)=+50 (μsec)
47
SERVO SIGNAL AREA
13
19-6
S#0
S#1
19-5
S#0
S#1
25 TIMES

FIG. 8

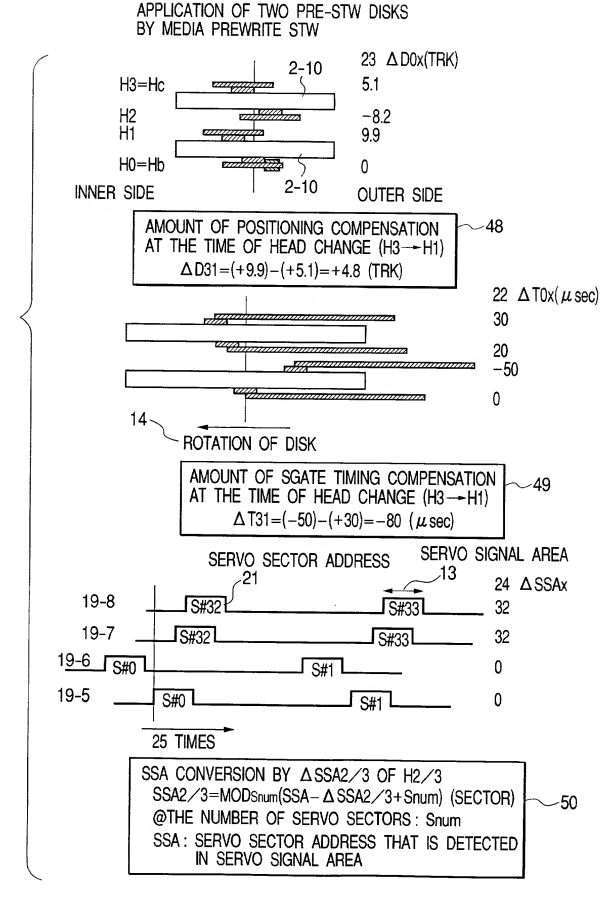

APPLICATION OF TWO PRE-STW DISKS
BY MEDIA PREWRITE STW
2-10
23 ΔD0x(TRK)
H3=Hc
5.1
H2
-8.2
H1
9.9
H0=Hb
0
2-10
INNER SIDE
OUTER SIDE
AMOUNT OF POSITIONING COMPENSATION
AT THE TIME OF HEAD CHANGE (H3→H1)
ΔD31=(+9.9)-(+5.1)=+4.8 (TRK)
48
22 ΔT0x(μsec)
30
20
-50
0
14
ROTATION OF DISK
AMOUNT OF SGATE TIMING COMPENSATION
AT THE TIME OF HEAD CHANGE (H3→H1)
ΔT31=(-50)-(+30)=-80 (μsec)
49
SERVO SECTOR ADDRESS
SERVO SIGNAL AREA
21
13
24 ΔSSAx
19-8
S#32
S#33
32
19-7
S#32
S#33
32
19-6
S#0
S#1
0
19-5
S#0
S#1
0
25 TIMES
SSA CONVERSION BY ΔSSA2/3 OF H2/3
SSA2/3=MODSnum(SSA-ΔSSA2/3+Snum) (SECTOR)
@THE NUMBER OF SERVO SECTORS : Snum
SSA : SERVO SECTOR ADDRESS THAT IS DETECTED
IN SERVO SIGNAL AREA
50

FIG. 9

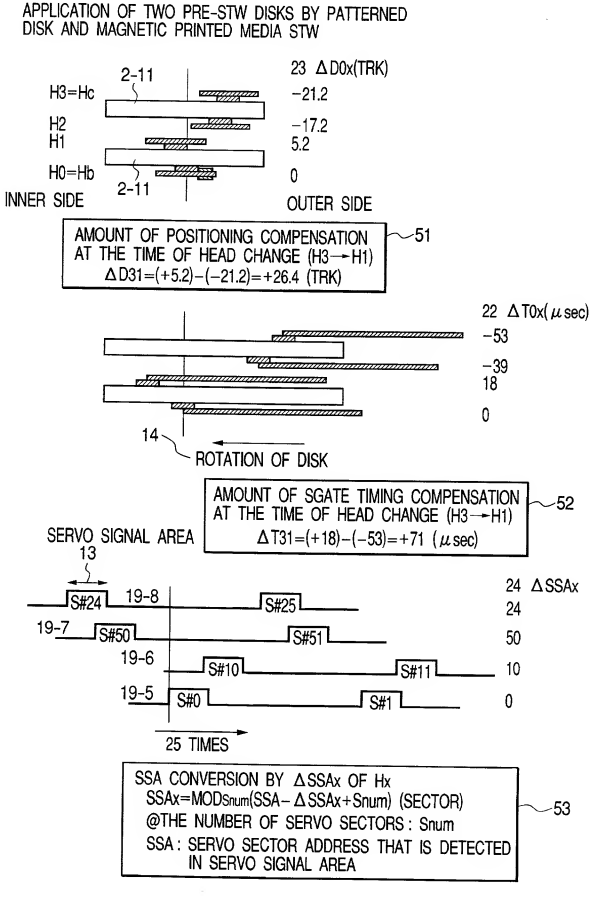

APPLICATION OF TWO PRE-STW DISKS BY PATTERNED DISK AND MAGNETIC PRINTED MEDIA STW
2-11
H3=Hc
H2
H1
H0=Hb
2-11
INNER SIDE
23 ΔD0x(TRK)
−21.2
−17.2
5.2
0
OUTER SIDE
AMOUNT OF POSITIONING COMPENSATION AT THE TIME OF HEAD CHANGE (H3→H1)
ΔD31=(+5.2)−(−21.2)=+26.4 (TRK)
51
22 ΔT0x(μsec)
−53
−39
18
0
14
ROTATION OF DISK
AMOUNT OF SGATE TIMING COMPENSATION AT THE TIME OF HEAD CHANGE (H3→H1)
ΔT31=(+18)−(−53)=+71 (μsec)
52
SERVO SIGNAL AREA
13
24 ΔSSAx
S#24
19-8
S#25
24
19-7
S#50
S#51
50
19-6
S#10
S#11
10
19-5
S#0
S#1
0
25 TIMES
SSA CONVERSION BY ΔSSAx OF Hx
SSAx=MODSnum(SSA−ΔSSAx+Snum) (SECTOR)
@THE NUMBER OF SERVO SECTORS : Snum
SSA : SERVO SECTOR ADDRESS THAT IS DETECTED IN SERVO SIGNAL AREA
53

FIG. 10

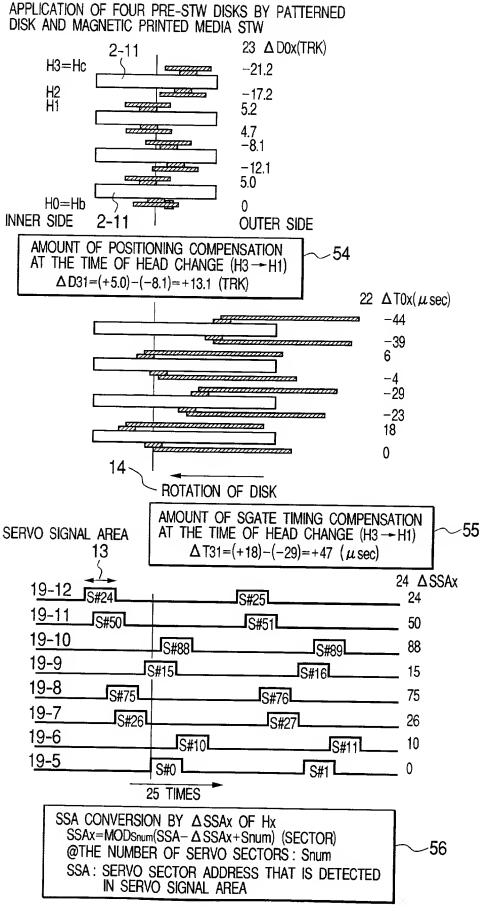

APPLICATION OF FOUR PRE-STW DISKS BY PATTERNED DISK AND MAGNETIC PRINTED MEDIA STW
2-11
23 ΔD0x(TRK)
H3=Hc
-21.2
H2
-17.2
H1
5.2
4.7
-8.1
-12.1
5.0
H0=Hb
0
INNER SIDE
2-11
OUTER SIDE
AMOUNT OF POSITIONING COMPENSATION AT THE TIME OF HEAD CHANGE (H3→H1)
ΔD31=(+5.0)-(-8.1)=+13.1 (TRK)
54
22 ΔT0x(μsec)
-44
-39
6
-4
-29
-23
18
0
14
ROTATION OF DISK
SERVO SIGNAL AREA
13
AMOUNT OF SGATE TIMING COMPENSATION AT THE TIME OF HEAD CHANGE (H3→H1)
ΔT31=(+18)-(-29)=+47 (μsec)
55
24 ΔSSAx
19-12
S#24
S#25
24
19-11
S#50
S#51
50
19-10
S#88
S#89
88
19-9
S#15
S#16
15
19-8
S#75
S#76
75
19-7
S#26
S#27
26
19-6
S#10
S#11
10
19-5
S#0
S#1
0
25 TIMES
SSA CONVERSION BY ΔSSAx OF Hx
SSAx=MODSnum(SSA-ΔSSAx+Snum) (SECTOR)
@THE NUMBER OF SERVO SECTORS : Snum
SSA : SERVO SECTOR ADDRESS THAT IS DETECTED IN SERVO SIGNAL AREA
56

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FIG. 11

CONFIGURATION OF HDA

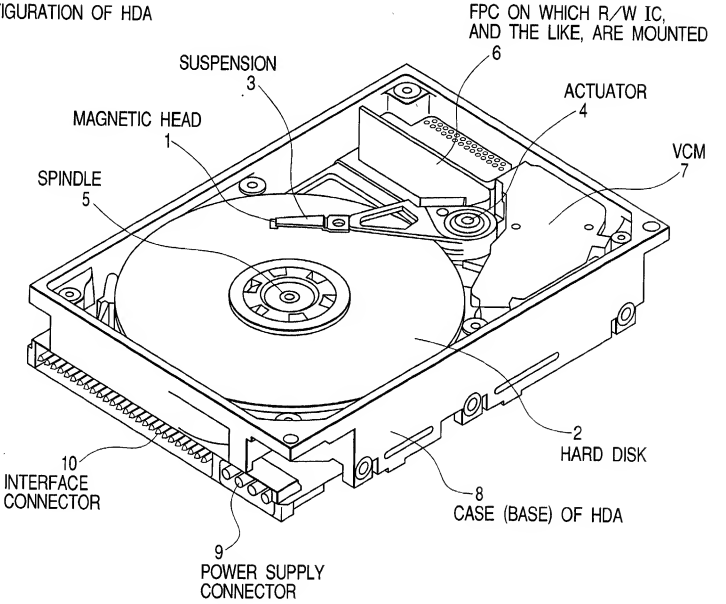


FIG. 12

CONFIGURATION OF HDD

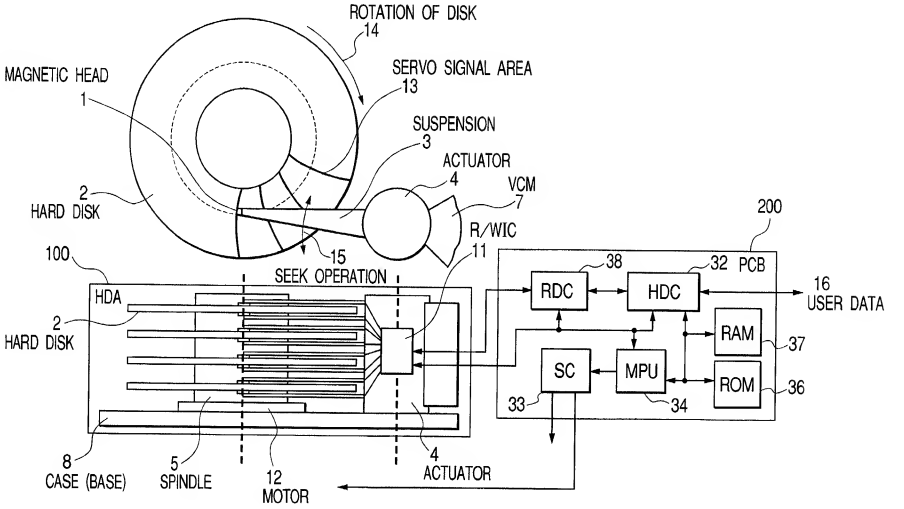


FIG. 13

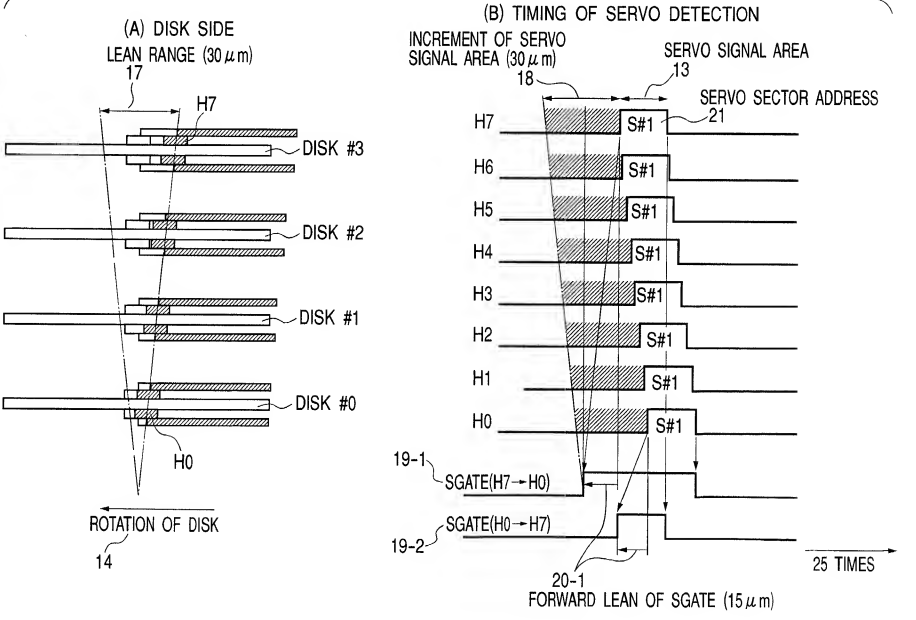

(A) DISK SIDE
LEAN RANGE (30 μm)
17
H7
DISK #3
DISK #2
DISK #1
DISK #0
H0
ROTATION OF DISK
14
(B) TIMING OF SERVO DETECTION
INCREMENT OF SERVO SIGNAL AREA (30 μm)
18
SERVO SIGNAL AREA
13
SERVO SECTOR ADDRESS
21
H7
H6
H5
H4
H3
H2
H1
H0
S#1
19-1
SGATE(H7→H0)
19-2
SGATE(H0→H7)
20-1
FORWARD LEAN OF SGATE (15 μm)
25 TIMES

FIG. 14

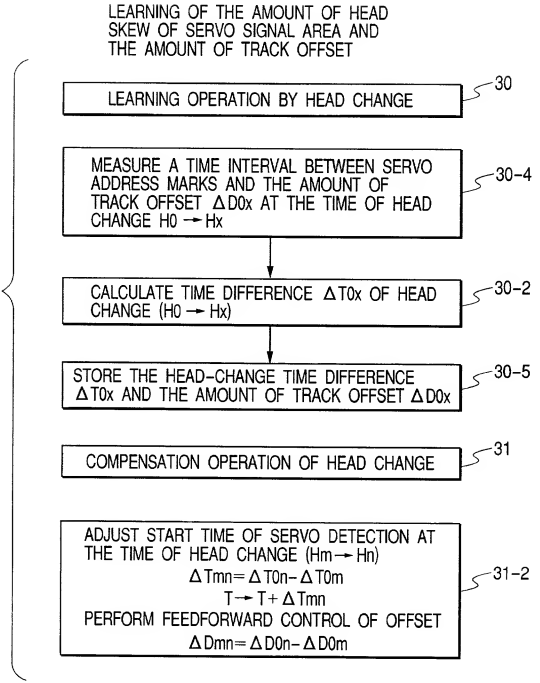

LEARNING OF THE AMOUNT OF HEAD SKEW OF SERVO SIGNAL AREA AND THE AMOUNT OF TRACK OFFSET
LEARNING OPERATION BY HEAD CHANGE
30
MEASURE A TIME INTERVAL BETWEEN SERVO ADDRESS MARKS AND THE AMOUNT OF TRACK OFFSET ΔD0x AT THE TIME OF HEAD CHANGE H0 → Hx
30-4
CALCULATE TIME DIFFERENCE ΔT0x OF HEAD CHANGE (H0 → Hx)
30-2
STORE THE HEAD-CHANGE TIME DIFFERENCE ΔT0x AND THE AMOUNT OF TRACK OFFSET ΔD0x
30-5
COMPENSATION OPERATION OF HEAD CHANGE
31
ADJUST START TIME OF SERVO DETECTION AT THE TIME OF HEAD CHANGE (Hm → Hn)
ΔTmn = ΔT0n - ΔT0m
T → T + ΔTmn
PERFORM FEEDFORWARD CONTROL OF OFFSET
ΔDmn = ΔD0n - ΔD0m
31-2

FIG. 15

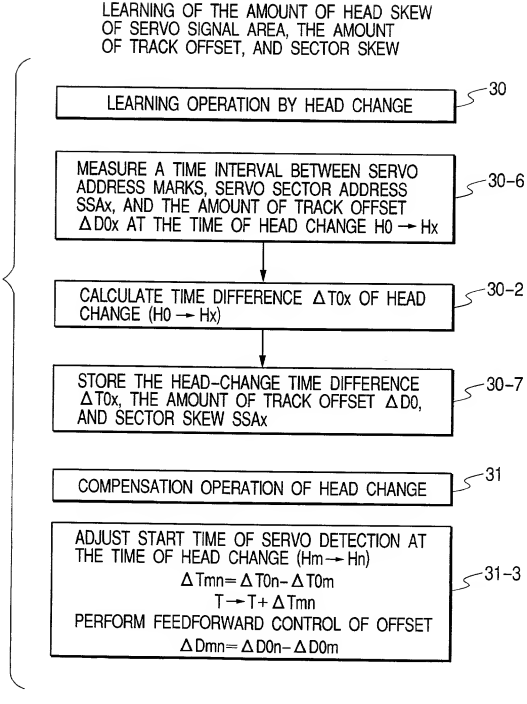

LEARNING OF THE AMOUNT OF HEAD SKEW OF SERVO SIGNAL AREA, THE AMOUNT OF TRACK OFFSET, AND SECTOR SKEW
LEARNING OPERATION BY HEAD CHANGE
30
MEASURE A TIME INTERVAL BETWEEN SERVO ADDRESS MARKS, SERVO SECTOR ADDRESS SSAx, AND THE AMOUNT OF TRACK OFFSET ΔD0x AT THE TIME OF HEAD CHANGE H0 → Hx
30-6
CALCULATE TIME DIFFERENCE ΔT0x OF HEAD CHANGE (H0 → Hx)
30-2
STORE THE HEAD-CHANGE TIME DIFFERENCE ΔT0x, THE AMOUNT OF TRACK OFFSET ΔD0, AND SECTOR SKEW SSAx
30-7
COMPENSATION OPERATION OF HEAD CHANGE
31
ADJUST START TIME OF SERVO DETECTION AT THE TIME OF HEAD CHANGE (Hm → Hn)
ΔTmn = ΔT0n − ΔT0m
T → T + ΔTmn
PERFORM FEEDFORWARD CONTROL OF OFFSET
ΔDmn = ΔD0n − ΔD0m
31-3

FIG. 16

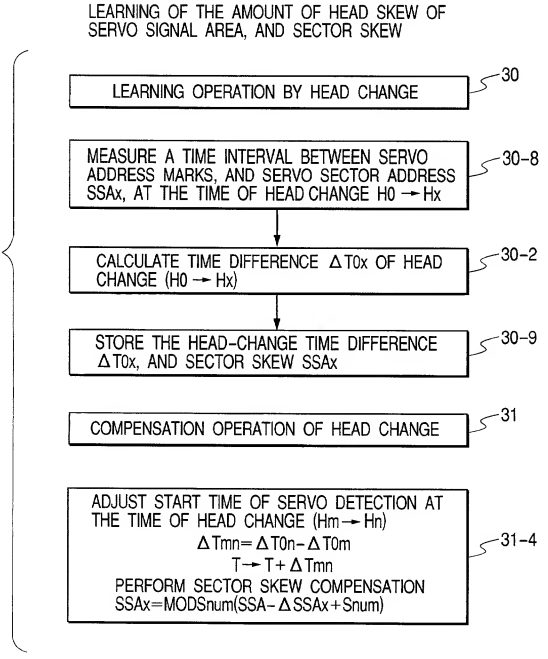

LEARNING OF THE AMOUNT OF HEAD SKEW OF SERVO SIGNAL AREA, AND SECTOR SKEW
LEARNING OPERATION BY HEAD CHANGE
30
MEASURE A TIME INTERVAL BETWEEN SERVO ADDRESS MARKS, AND SERVO SECTOR ADDRESS SSAx, AT THE TIME OF HEAD CHANGE H0 → Hx
30-8
CALCULATE TIME DIFFERENCE ΔT0x OF HEAD CHANGE (H0 → Hx)
30-2
STORE THE HEAD-CHANGE TIME DIFFERENCE ΔT0x, AND SECTOR SKEW SSAx
30-9
COMPENSATION OPERATION OF HEAD CHANGE
31
ADJUST START TIME OF SERVO DETECTION AT THE TIME OF HEAD CHANGE (Hm → Hn)
ΔTmn = ΔT0n - ΔT0m
T → T + ΔTmn
PERFORM SECTOR SKEW COMPENSATION
SSAx = MODSnum(SSA - ΔSSAx + Snum)
31-4

FIG. 17

TWO DISKS BUILT INTO MOBILE COMPUTING DEVICE

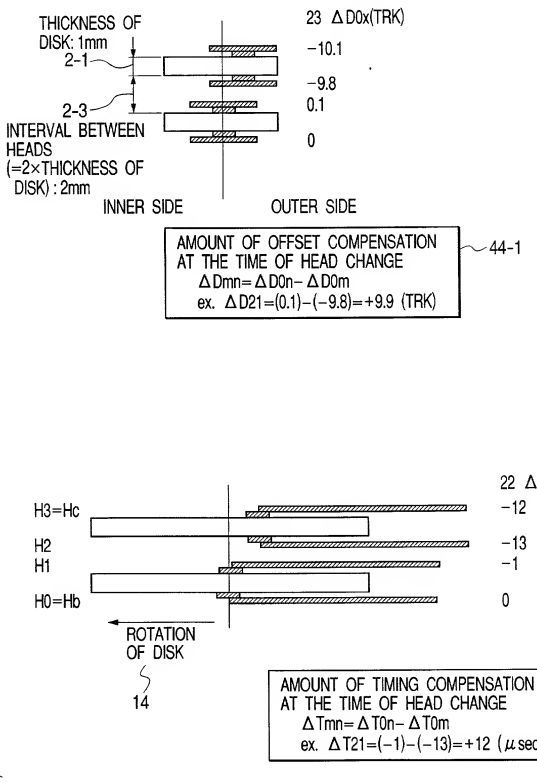
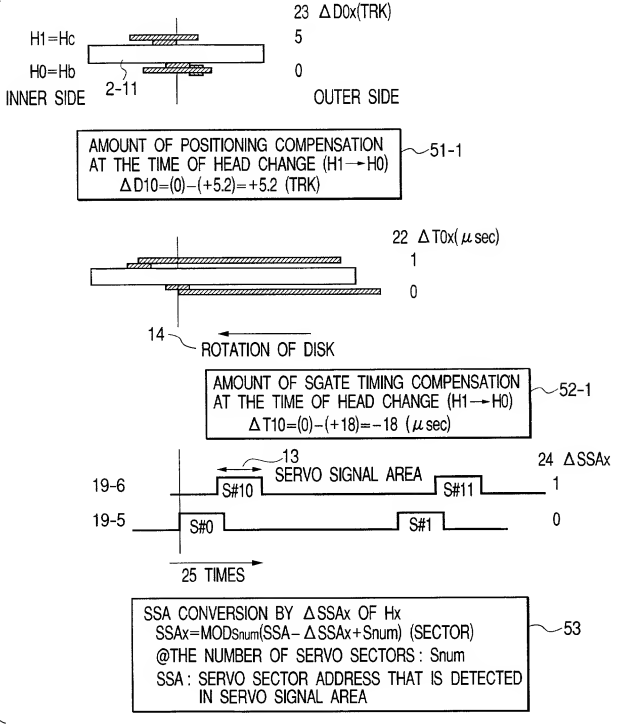


FIG. 18

APPLICATION OF ONE PRE-STW DISK BY PATTERNED DISK AND MAGNETIC PRINTED MEDIA STW